PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

United States Patent and Trademark Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 15 December 1998 (15.12.98)	
International application No. PCT/NO98/00121	**Applicant's or agent's file reference** AF/85256
International filing date (day/month/year) 17 April 1998 (17.04.98)	**Priority date** (day/month/year) 18 April 1997 (18.04.97)
Applicant LEIRFALL, Lasse	

1. The designated Office is hereby notified of its election made:

   [X] in the demand filed with the International Preliminary Examining Authority on:

   16 November 1998 (16.11.98)

   [ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

   [ ] was not

   made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Aino Metcalfe
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G01N 21/47 — A1

(11) International Publication Number: **WO 98/48261**

(43) International Publication Date: 29 October 1998 (29.10.98)

(21) International Application Number: PCT/NO98/00121

(22) International Filing Date: 17 April 1998 (17.04.98)

(30) Priority Data:
971822 18 April 1997 (18.04.97) NO

(71)(72) Applicant and Inventor: LEIRFALL, Lasse [NO/NO]; Solbakken, N-4790 Lillesand (NO).

(74) Agent: FRIBERG, Arild; Bryn & Aarflot a/s, P.O. Box 449 Sentrum, N-0104 Oslo (NO).

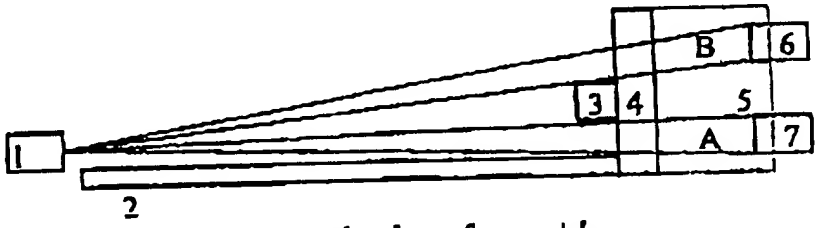
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.
In English translation (filed in Norwegian).

(54) Title: MONITORING DUST DEPOSITION

(57) Abstract

A method and a means for monitoring a contaminated or inflammable condition in an appliance or an installation is based on measuring deposited amount of dust on a surface in the appliance/installation. A measurement device of optical, thermal or mechanical type is attached signal-wise to an indicator that displays a value or provides an indication of a parameter attached to the deposited amount of dust.



Dustdetektor from side

ATTACHMENT A

PATENT COOPERATION TREATY

09/403090

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
FRIBERG, Arild
Bryn & Aarfl t a/s
P.O. Box 449 Sentrum
N-0104 Oslo
NORVÈGE

9 NOV. 1998

Date of mailing (day/month/year)	
29 October 1998 (29.10.98)	
Applicant's or agent's file reference AF/85256	**IMPORTANT NOTICE**
International application No. PCT/NO98/00121	**International filing date** (day/month/year) 17 April 1998 (17.04.98)
Priority date (day/month/year) 18 April 1997 (18.04.97)	
Applicant LEIRFALL, Lasse	

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   AU,BR,CA,CN,EP,IL,JP,KP,KR,NO,PL,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AL,AM,AP,AT,AZ,BA,BB,BG,BY,CH,CU,CZ,DE,DK,EA,EE,ES,FI,GB,GE,GH,GM,GW,HU,ID,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NZ,OA,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZW
   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   29 October 1998 (29.10.98) under No. WO 98/48261

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

Form PCT/IB/308 (July 1996)

2310046

ATTACHMENT B

09/403090 19

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
AE/85256		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NO98/00121	17/04/1998	18/04/1997
International Patent Classification (IPC) or national classification and IPC G01N21/47		
Applicant LEIRFALL, Lasse		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
16/11/1998	11.05.99
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. (+49-89) 2399-0 Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer Thomt , M Telephone No. (+49-89) 2399 2610

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NO98/00121

I. Basis of th r port

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-8 as originally filed

Claims, No.:

1-13 as originally filed

Drawings, sheets:

1/4-4/4 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Articl 35(2) with r gard to nov lty, inventive st p or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-13
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-13
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-13
	No:	Claims	

2. Citations and explanations

see separate sheet

ad Section V

1. The common concept linking the independent claims 1, 2, 6, 9, 10 and 11 is to make **use** of a measuring device for monitoring dust in an electrical consumer appliance.

2. Since none of the available prior art documents cited in the International Search Report reveals any means for monitoring dust in any such appliances, the subject-matter of claims 1, 2, 6 9, 10 and 11 is novel (Art. 33(2) PCT).

3. The arguments of the Applicant supporting the inventive merit of said concept (see 1 and 2 of the description) have been adopted. Thus, in view of that none of the available prior art even hints to the provision of measuring dust in any household environment whatsoever and since the problem of detecting the building up of dust in e.g. TV-sets, stoves, etc. apparently may be considered to constitute a long felt need, the concept of using a measuring device for monitoring dust in consumer appliances as defined by the independent claims must therefore be held to involve an inventive step. For said reasons the independent claims 1, 2, 6, 9, 10 and 11 fulfil the requirements of Article 33(3) PCT.

4. The requirement of Article 33(4) PCT as to industrial applicability is also fulfilled for all independent claims.

5. The dependent claims on file define advantageous embodiments depending on the independent claims. Thus, dependent claims 3, 4 - 8, 12 and 13 do also fulfil the requirements of Articles 33(2), (3) and (4) PCT.

09/403090

PCT

RECORD COPY

For receiving Office use only

International Application No. PCT/NO 98 / 00121

International Filing Date 17 APR. 1998 (17.04.98)

Name of receiving Office and "PCT International Application" Patentstyret
STYRET FOR DET INDUSTRIELLE RETTSVERN
PATENTINNGANGET I APPLIKATION

Applicant's or agent's file reference (if desired) (12 characters maximum) AF/85256

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

Box No. I TITLE OF INVENTION

MONITORING DUST DEPOSITION

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

LEIRFALL, Lasse
Solbakken
4790 Lillesand
Norway

[X] This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(i.e. country)* of nationality: Norway

State *(i.e. country)* of residence: Norway

This person is applicant for the purposes of: [X] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

This person is:

[ ] applicant only

[ ] applicant and inventor

[ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

[ ] Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: [X] agent [ ] common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

FRIBERG, Arild
BRYN & AARFLOT A/S
P.O.BOX 449 SENTRUM
N-0104 OSLO
NORWAY

Telephone No. 22 00 31 00

Facsimile No. 22 00 31 31

Teleprinter No. 19168 arflot n

[ ] Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box N .V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regi nal Patent

- [X] AP **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **SD** Sudan, **SZ** Swaziland, **UG** Uganda, **ZW** Zimbabw , and any other State which is a Contracting State of the Harare Protocol and of the PCT
- [X] EA **Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- [X] EP **European Patent:** **AT** Austria, **BE** Belgium, **CH and LI** Switzerland and Liechtenstein, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- [X] OA **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- [X] AL Albania .....
- [X] AM Armenia .....
- [X] AT Austria .....
- [X] AU Australia .....
- [X] AZ Azerbaijan
- [X] BA Bosnia and Herzegovina .....
- [X] BB Barbados
- [X] BG Bulgaria .....
- [X] BR Brazil .....
- [X] BY Belarus
- [X] CA Canada
- [X] CH and LI Switzerland and Liechtenstein
- [X] CN China .....
- [X] CU Cuba .....
- [X] CZ Czech Republic .....
- [X] DE Germany .....
- [X] DK Denmark .....
- [X] EE Estonia .....
- [X] ES Spain .....
- [X] FI Finland .....
- [X] GB United Kingdom
- [X] GE Georgia .....
- [X] GH Ghana .....
- [X] GM Gambia
- [X] GW Guinea-Bissau .....
- [X] HU Hungary .....
- [X] ID Indonesia
- [X] IL Israel .....
- [X] IS Iceland
- [X] JP Japan .....
- [X] KE Kenya .....
- [X] KG Kyrgyzstan .....
- [X] KP Democratic People's Republic of Korea .....
- [X] KR Republic of Korea .....
- [X] KZ Kazakhstan .....
- [X] LC Saint Lucia
- [X] LK Sri Lanka
- [X] LR Liberia
- [X] LS Lesotho .....
- [X] LT Lithuania
- [X] LU Luxembourg
- [X] LV Latvia
- [X] MD Republic of Moldova .....
- [X] MG Madagascar .....
- [X] MK The former Yugoslav Republic of Macedonia .....
- [X] MN Mongolia
- [X] MW Malawi .....
- [X] MX Mexico .....
- [X] NO Norway
- [X] NZ New Zealand .....
- [X] PL Poland .....
- [X] PT Portugal .....
- [X] RO Romania
- [X] RU Russian Federation .....
- [X] SD Sudan
- [X] SE Sweden
- [X] SG Singapore
- [X] SI Slovenia .....
- [X] SK Slovakia .....
- [X] SL Sierra Leone
- [X] TJ Tajikistan .....
- [X] TM Turkmenistan .....
- [X] TR Turkey .....
- [X] TT Trinidad and Tobago .....
- [X] UA Ukraine .....
- [X] UG Uganda .....
- [X] US United States of America .....
- [X] UZ Uzbekistan .....
- [X] VN Viet Nam .....
- [X] YU Yugoslavia .....
- [X] ZW Zimbabwe .....

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

- [X] Cyprus .....
- [ ] .....
- [ ] .....

In additi n to the designations made ab ve, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except the designati n(s) of _____.

The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM Further priority claims are indicated in the Supplemental Box ☐

The priority of the following earlier application(s) is hereby claimed:

Country (in which, or for which, the application was filed)	Filing Date (day/month/year)	Application No.	Office of filing (only for regional or international application)
item (1) Norway	(18.04.97) 18 April 1997	97.1822	
item (2)			
item (3)			

Mark the following check-box if the certified copy of the earlier application is to be issued by the Office which for the purposes of the present international application is the receiving Office (a fee may be required):

☒ The receiving Office is hereby requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s): (1) 97.1822

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):* ISA / SE

Earlier search *Fill in where a search (international, international-type or other) by the International Searching Authority has already been carried out or requested and the Authority is now requested to base the international search, to the extent possible, on the results of that earlier search. Identify such search or request either by reference to the relevant application (or the translation thereof) or by reference to the search request:*

Country (or regional Office): Date *(day/month/year)*: Number:

Box No. VIII CHECK LIST

This international application contains the following number of sheets:

1. request	3	sheets
2. description	7	sheets
3. claims	3	sheets
4. abstract	1	sheets
5. drawings	3	sheets
Total	17	sheets

This international application is accompanied by the item(s) marked below:

1. ☐ separate signed power of attorney
2. ☐ copy of general power of attorney
3. ☐ statement explaining lack of signature
4. ☐ priority document(s) *identified in Box No. VI as item(s):*
5. ☐ fee calculation sheet
6. ☐ separate indications concerning deposited microorganisms
7. ☐ nucleotide and/or amino acid sequence listing (diskette)
8. ☒ other *(specify)*: Copy of Official Action

Figure No. 1b of the drawings (if any) should accompany the abstract when it is published.

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Arild Friberg

Cand. real. Arild Friberg
I firma
BRYN & AARFLOT AS
Kongensgt. 15
0153 Oslo 1

For receiving Office use only

1. Date of actual receipt of the purported international application: 17 APR. 1998 (17.04.98)
2. Drawings: ☒ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority specified by the applicant: ISA / SE
6. ☐ Transmittal of search copy delayed until search fee is paid

For International Bureau use only

Date of receipt of the record copy by the International Bureau: 15 MAY 1998 (15.05.98)

INDIKERING AV STØVAVSETNING

Foreliggende oppfinnelse angår indikering av en forurenset, tilsmusset eller brannfarlig tilstand på grunn av nedslagsstøv. Mer spesielt er oppfinnelsen rettet mot en ny anvendelse av støvdeteksjonsutstyr for varsling om tilstedeværelse eller mengde av støv eller fine partikler på en flate i et apparat.

En hovedhensikt med en indikator for nedslagsstøv er forebyggelse av brann og eksplosjoner. En kan imidlertid se flere viktige hensikter, f.eks. a) det å kunne hindre spesiell lukt i forbindelse med støv/partikkelansamlinger, b) det å kunne forbedre effekten på f.eks. kjøleaggregater ved å forebygge store støvansamlinger på kjøleribber, hvilket svekker varmevekslingsevnen, c) generell bedring/effektivisering av renholds/service/vedlikeholdsprogrammer, dvs. lettere konstatering av behov for rensing, d) det å kunne holde viktige parametere ved elektriske/elektroniske apparater innenfor gitte toleranser.

Generelt er det kjent å måle støv- og partikkelansamlinger, men slike målinger foretas typisk i industriell- eller forsknings-sammenheng. F.eks. viser US patent nr. 4,793,710 en fremgangsmåte for måling av støvlag i kullgruver, basert på en optisk teknikk, og US patent nr. 5,412,221 angår også en optisk målemetode for små partikkelavsetninger ("fallout") i forbindelse med romforskning. US patent nr. 5,229,602 omhandler en optisk metode for deteksjon av forurensningslag spesielt på gjennomsiktige flater (lykteglass, frontvindu) på kjøretøyer.

Foreliggende oppfinnelse baserer seg imidlertid på et behov for sikring av liv, helse og verdier også i normale forbrukermiljøer, og da basert på løsninger som kan masseproduseres for en billig penge, spesielt slik at måle- og fremvisningsutstyr kan integreres i et apparat som er vanlig i et slikt normalt forbrukermiljø.

I et forbrukermarked som omfatter produkter av typen TV-apparater, audio- og videoapparater, større husholdningsapparater som kjøleskap, komfyrer etc., små husholdningsapparater som kaffetraktere etc., apparater for personlig pleie, dataprodukter som PC'er og tilleggsutstyr til slike, elektriske installasjoner i bolighus, slik som sikringsbokser/tavler, panelovner, lamper osv., ses det at en støvindikator kan være av stor interesse, også i forbindelse med de allergiproblemer som mange personer lider av. En god påvisning av støvansamling i en

allergikers nærmiljø kan gi godt grunnlag for påvisning av effektiviteten av eventuelle mottiltak, eller gi grunnlag for igangsettelse av slike mottiltak.

Når det gjelder vanlig rengjøring, kan selvfølgelig også en støvindikator ifølge oppfinnelsen være et hjelpemiddel, ganske enkelt til å fastslå behovet for vanlig rengjøring.

Når man i herværende beskrivelse av oppfinnelsen, samt i patentkravene benytter ordet "støv", tenker man seg støv av forskjellige typer, fine partikler, smuss osv. Et utgangspunkt er at det smuss det her dreier seg om, er nedslagssmuss av partikler som i en viss tid kan sveve i luften. Innenfor begrepet støv kan man forøvrig skille mellom husstøv, industristøv og trafikkstøv. Husstøv er en blanding av stoffibre (ulike former for stoffer slik som bomull), og pollen (ulike former for pollen, dvs. korn, gress, blomsterstøv etc.). Industristøv er forskjellige typer avfallsstoffer som slipestøv fra tre og metaller, samt andre avfallsstoffer (forurensning). Trafikkstøv er en blanding av asfalt, eksos og forskjellige former for gasser (forurensning).

Hensikten med oppfinnelsen er således å gi varsling/indikasjon vedrørende ansamling av støv på viktige steder for forbrukere, og ifølge oppfinnelsen er dette muliggjort gjennom en anvendelse av den type som defineres i de vedføyde patentkravene.

I det følgende skal oppfinnelsen belyses nærmere ved gjennomgåelse av visse utførelseseksempler, og det skal i denne forbindelse vises til de vedføyde tegningene, hvor

fig. 1a og 1b viser skjematisk en støvmåler av optisk type, sett ovenfra og fra siden,

fig. 2 viser et kretsskjema for en optisk detektor som benyttes i støvmåleren vist i fig. 1a og 1b,

fig. 3a og 3b viser en støvmåler av termisk type, sett ovenfra og fra siden,

fig. 4 viser et kretsskjema for en detektor i forbindelse med den termiske støvmåleren vist i fig. 3a og 3b, og

fig. 5 viser en støvmåler som kan anvendes ifølge oppfinnelsen, på sin mest generelle form.

En konkret anvendelse ifølge oppfinnelsen er, som nevnt ovenfor, i forbindelse med deteksjon og varsling vedrørende støvansamling i et TV-apparat. De utførelser som nå skal omtales med henvisning til tegningen, tenkes satt inn i

en slik sammenheng, men det understrekes igjen at også andre forbruker-apparater er aktuelle, som tidligere forklart. I fig. 1a og 1b er vist et skjematisk opplegg for en støv-måler som skal kunne monteres inne i et TV-apparat. En plate 2, som fortrinnsvis er anordnet horisontalt, vil etterhvert oppsamle støv og partikler som avsettes fra luftrommet over platen. Ved venstre ende av platen 2 er det anbrakt en lyskilde 1, som sender lys på en slik måte at det brer seg i det minste langsetter platens 2 overside, og i tillegg i et rom over platen som antas ikke å inneholde noe støv, dvs. i såpass høyde over platen at det er usannsynlig at et støvlag noen gang skal kunne vokse så høyt. De to hovedsakelige lysbanene fremgår av fig. 1b, dvs. to lysbaner angitt ved hjelp av to divergerende, stiplede strek-par. (Lys kan selvfølgelig bre seg også utenfor disse retningene, men dette er da lys som ikke blir brukt til noe i forbindelse med selve målingen.)

En skjerm 3 sørger for å danne et skille mellom de to aktuelle lysstrålene, som benevnes A og B, dvs. A i støvlags-området, B i luftrommet over støvlaget.

Slik det fremgår av fig. 1a, er det gunstig å la lysstrålen være bred, eller å bre seg ut slik som vist i figuren, langs støvlaget, for å øke målingens følsomhet og gjøre usikkerheten mindre. En linse 4 samler begge de to stråledelene A og B til hvert sitt deteksjonsområde, hvor to separate detektorer 6, 7 måler lysintensi-tetene. Linsen 4 kan være en normal samlelinse, eller slik som indikert på figuren, en sylindrisk linse, idet det kan være tilstrekkelig å fokusere lyset i horisontal-planet. Det vil være gunstig å bygge inn begge detektorer 6, 7, linsen 4 og skjermen 3 i en tett boks 5, i figuren indikert ved stiplede streker.

Intensiteten av lysstråle A vil reduseres når støvtykkelsen på platen 2 vokser, mens referanselyset i stråle B ikke vil bli påvirket av dette støvlaget. Støv på lyskilden 1 vil dempe begge stråler like mye. Man kan justere den registrerbare støvtykkelsen mekanisk ved å tilpasse høyden av lysspalten mellom skjermen 3 og platen 2. Oversiden av platen 2 bør være matt, for at man skal unngå reflek-sjoner. Som nevnt, er det gunstig å ha en lysstråle med en viss bredde i horisontalplanet, og dette kan eksempelvis oppnås ved en (ikke vist) linse mellom lyskilden og planet 2, eller ved at lyskilden gir fra seg en relativt bred stråle slik som vist i fig. 1a.

Når det så gjelder den elektriske/elektroniske siden av saken, vises det til fig. 2, som viser en greit realiserbar utforming av de elektriske kretsene som er nødvendige i tilknytning til oppstillingen i fig. 1a/1b. Lyskilden 1 er vist i en enkel

krets til venstre i figuren, som en lysdiode (LED), og i deteksjonskretsen til høyre i figuren, vises detektorene 6 og 7 som fototransistorer enkelt oppstilt for å gi inngangssignaler til en differensialforsterker 8. (Det er også mulig å benytte fotodioder.) Etterhvert som støvtykkelsen øker, og altså stråle A svekkes, forrykkes forholdet mellom de to spenningene inn på differensialforsterkeren, og utgangsspenningen fra differensialforsterkeren 8 vil f.eks. øke. Dette detekteres ved hjelp av komparatoren 9, som sammenligner med en fast referansespenning tatt fra en enkel spenningsdeler. Dersom utgangen fra komparatoren 9 overskrider en viss spenning, tennes alarm-lysdioden 10, og dette representerer en mulig indikasjon av at en uønsket støvlagstykkelse er nådd.

Elektronikken etter fotodetektorene 6, 7 vil i realiteten være avhengig av hvordan den eventuelle støvregistreringen skal indikeres, dvs. om det, slik som her vist, skal foregå tenning av en lysdiode, om en måleverdi skal fremvises på et display, eller eventuelt på en TV-skjerm, eller en spesiell indikasjon kan også være å kutte forsyningsspenningen til TV-apparatet.

I det viste eksempelet markeres altså nådd støvgrense ved å tenne en lysdiode, og ved å gi ut et logisk høyt signal på utgangen. Det er imidlertid fullt mulig å gradere alarmen til angivelse av flere støvtykkelser, men dette krever da en noe annerledes kretsløsning enn den viste.

Dersom detektoren skal stå i et område der det slipper inn lys, bør lyskilden 1 moduleres, slik at mottakerdelen kan AC-kobles, noen slik løsning er heller ikke vist på tegningene. Løsningen med en modulert lyskilde vil selvfølgelig ha en litt høyere kostnad.

Rent prinsipielt vil det selvfølgelig også være mulig å sende lys "på tvers" av støvlaget, altså i fig. 1b med en lyskilde som står over platen 2, fortrinnsvis med et lysstråle-ekspanderende element i form av en linse, med gjennomsiktig eller reflekterende plate 2, og med deteksjon under eller over platen henholdsvis. En referansemåling må da foretas på annen måte, f.eks. med en detektor tilknyttet lyskilden i støvfri sammenheng, dvs. innebygget sammen med lyskilden.

Forsøk som er utført i henhold til den løsning som vises i fig. 1a, 1b og fig. 2, viser at lyset som går langs støvflaten, vil dempes tilnærmet proporsjonalt med støvtykkelsen. Forsøkene indikerer videre at støvlagets tetthet har liten betydning med denne deteksjonsløsningen.

Helt andre måleteknikker enn optisk deteksjon kan også benyttes når det gjelder deteksjon av støvbelegg, og i fig. 3a og 3b vises en termisk detektor for samme formål. Prinsippet som her benyttes, bygger på at et støvbelegg vil virke isolerende, slik at temperaturen i en oppvarmet flate vil øke med økende støvtykkelse. For å oppnå sikker deteksjon, bør det benyttes en referansemåling mot et punkt som ikke er avhengig av støvbelegget.

Den termiske detektoren bygges opp på et isolerende underlag D for å holde varmetapet minst mulig den veien. Varmeelementer kan være to parallellkoblede motstander 11 og 12, som i fig. 3a, som viser detektoren ovenfra, er plassert på henholdsvise kjøleflater 15 og 16. Kjøleflaten 15 er selve støvsensoren, som etterhvert skal belegges med støv, mens kjøleflaten 16 er en referanse. Kjøleflaten 16 gjøres ufølsom for støv ved å dekke den med et ikke altfor tykt isolasjonslag E. Det er her en hensikt at den termiske motstanden gjennom isolasjonslaget E skal være vesentlig høyere enn den termiske motstanden i et støvbelegg, slik at et slikt støvbelegg ikke påvirker utstrålingen fra kjøleflaten. For likevel å oppnå tilstrekkelig kjøling, gjøres denne flaten relativt stor.

Som temperaturfølere 13 og 14 benyttes fortrinnsvis termistorer. (Andre typer følere er selvfølgelig også aktuelle, f.eks. termoelementer.) Støvsensoren, dvs. kjøleflaten 15, vil få redusert kjøleeffekt når den etterhvert dekkes med et støvlag, slik at temperaturen i termoføler 13 vil være en funksjon av støvtykkelsen. Temperaturen i termoføleren 14 vil derimot holde seg i hovedsak konstant, selv om støv legger seg oppå isolasjonslaget E.

Inne ved termofølerne 13 og 14 bør temperaturen være vesentlig høyere enn romtemperatur. Dette oppnås ved å tilføre tilstrekkelig effekt (ca. 1-5 watt), og å isolere over termofølerne og varmeelementene (isolasjonslag C). De fysiske dimensjonene kan være ca. 5 x 5 cm, og med største høyde ca. 2 cm, se fig. 3b.

Et eksempel på et kretsskjema tilknyttet den termiske detektoren som er vist skjematisk i fig. 3a og 3b, fremgår av fig. 4. I eksempelet på fig. 4 er den avsluttende del av deteksjonskretsen ganske lik det som fremgikk av fig. 2 vedrørende den optiske deteksjonskretsen, dvs. fra differensialforsterkeren 17 gjennom komparatoren 18 og ut til en alarm-lysdiode 19. Fototransistorene 6 og 7 i fig. 2 er imidlertid byttet ut med termistorer 13 og 14 i fig. 4, for avgivelse av signalspenninger inn til differensialforsterkeren 17. Hver av termistorene 13 og 14

inngår i en spenningsdeler sammen med motstander, henholdsvis R2 og R1. Varmeelementene 11 og 12 inngår i en separat, enkel parallell-krets.

Alle motstander i den viste kretsen, innbefattende varmeelementene, bør ha toleranse 1% eller bedre, mens nøyaktigheten på forsyningsspenningen U ikke er kritisk.

Begge de beskrevne løsningene for deteksjon av støvlag-tykkelse er enkle, og totalpris i storproduksjon kan forventes å ligge under kr. 10 i begge alternativer, idet den termiske løsningen vil være billigst.

En ytterligere mulighet for deteksjon av et støvlag, er en mekanisk avføling, som kan være basert på et strekk- eller et trykkprinsipp. Strekkprinsippet er basert på bøying av en plate på grunn av støvtyngden. I et slikt tilfelle kan en strekklapp være selve føleren. Når trykkprinsippet benyttes, registrerer en trykksensor under en oppsamlingsflate vekten av støvlaget, dvs. det overtrykk som etter hvert kommer i tillegg til det innledende trykk på grunn av selve flatens/platens tyngde.

Uavhengig av hva slags type sensor som benyttes, vil normalt et signal fra sensoren måtte forsterkes, dvs. den forsterker som følger etter, skal registrere strøm eller spenning fra sensoren, og tilpasse nivået til fremvisningsenheten, som kan være av forskjellige typer. For å kunne måle relativt, bør forsterkeren være en differensialforsterker med sensor i en målebro.

Når det gjelder fremvisningsenheten, kan denne være av flere forskjellige typer. Slik som vist i fig. 2 og fig. 4, foregår fremvisningen ved hjelp av en enkel lysdiode, som altså tennes når støvlaget får en viss tykkelse. Det er selvfølgelig også mulig med et display av mer avansert type, f.eks. for fremvisning av hvor tykt støvlaget egentlig er, målt i en passende enhet. Et syv-segment type display, eller et intelligent display kan da benyttes. Ytterligere muligheter er at fremvisnings-enheten kan styre en strømbryter for å slå av det aktuelle apparatet dersom støvtykkelsen overstiger en kritisk verdi. Ytterligere muligheter er tilkobling til en monitorskjerm med mulighet for tekst på skjermen. Denne sistnevnte løsningen kan f.eks. være aktuell dersom støvvarsleren skal være innebygd på integrert måte i et fjernsynsapparat eller en datamonitor.

I dette sistnevnte tilfelle, er det gunstig å lage støvvarsleren som en egen enhet, eller eventuelt som en integrert del av et apparat. Dersom støvvarsleren lages som en egen enhet, må den egne seg til ettermontering. Som en integrert

del, vil den inngå som et produksjonselement i et apparat, f.eks. et TV-apparat, og som tidligere nevnt, eventuelt til en svært billig pris.

Spenningsforsyningen kan være standardisert f.eks. til 5,0 volt. Denne spenningen skal kunne variere innenfor et gitt område, uten å påvirke støv-varslerens pålitelighet.

Som tidligere nevnt er det gunstig å basere støvsensoren på relative målinger, slik at ytre, falske påvirkninger ikke skal forstyrre.

Rent generelt er det viktig å understreke at den "varsling" som skal skje, kan foregå på forskjellige måter. Slik som nevnt ovenfor, ser en lettest for seg en lysindikator på en eller annen form (en ytterligere slik indikator kan være en enkel, lysende angivelse med farge som avhenger av støvmengden), men det kan være aktuelt også å benytte et akustisk signal, dvs. en eller annen form for lydavgivelse, og en tekst-angivelse, f.eks. som nevnt i forbindelse med TV-apparat/dataskjerm ovenfor, er en viktig mulighet. En ser selvfølgelig også for seg en kombinasjon av disse angivelsesmåter.

Det synes også gunstig i visse anvendelser, med en mulighet for at displayet kan gi informasjon om at systemet fungerer, og at det er i drift.

I fig. 5 vises en støvmåleanordning på sin mest generelle form, slik som omtalt foran, dvs. uavhengig av det fysiske måleprinsippet som kan være optisk, termisk, vektbasert, ultralydbasert, eventuelt basert på måling av elektriske egenskaper som resistans, kapasitans osv. Absorpsjon/svekning av annen type stråling enn optisk og ultralyd-stråling kan tenkes, f.eks. radioaktiv stråling med strålingskilde à la den som benyttes i røkdetektorer. I figuren omfatter altså "støvsensoren", som normalt vil ha behov for en spenningsforsyning, en eller annen slik sensortype som kan avgi et signal som avhenger av støvmengden som måles. Signalet går til en forsterker, som leverer et utsignal videre til en display-enhet og eventuelt til en alarmenhet. Displayenheten kan gjerne omfatte eller være knyttet til en monitorskjerm, og den kan eventuelt være påslagbar med en bryter.

PATENTKRAV

1. Anvendelse av en måleanordning (1, 6-9; 11-14, 17, 18) for måling av en parameter som angir avsatt støvmengde på en flate, samt av en indikator (10, 19) signalmessig forbundet med måleanordningen for angivelse av en indikasjon for parameteren,
for indikering av en forurenset, tilsmusset eller brannfarlig tilstand i et elektrisk forbruker-apparat, f.eks. et TV-apparat.

2. Anvendelse av en optisk måleanordning (1, 6-9) for måling av svekning av en lysstråle (A) som sendes gjennom en støvmengde avsatt på en flate, samt av en indikator (10) forbundet med måleanordningen (1, 6-9) for angivelse av en måleverdi som er en funksjon av svekningen,
for indikering av støvtykkelse i et elektrisk forbruker-apparat, f.eks. et TV apparat.

3. Anvendelse ifølge krav 2,
hvor den gjennomgående lysstrålens (A) utgangsintensitet sammenlignes med intensiteten av en referanselysstråle (B) som går utenom støvmengden.

4. Anvendelse ifølge krav 2 eller 3,
hvor lysstrålen (A) sendes på langs gjennom støvlaget, eventuelt som en divergent eller ekspandert stråle for økning av måleføIsomheten, og som da eventuelt fokuseres mot en fotodetektor (7) med en linse (4) plassert etter flaten.

5. Anvendelse ifølge krav 2 eller 3,
hvor lysstrålen sendes hovedsakelig på tvers av støvlaget, eventuelt med refleksjon mot den underliggende flaten slik at støvlaget passeres to ganger før deteksjon.

6. Anvendelse av en termisk måleanordning (11-14, 17, 18) for måling av varmeisolerende evne for en støvmengde avsatt på en flate, samt av en indikator (19) forbundet med måleanordningen for angivelse av en måleverdi som er en funksjon av den varmeisolerende evnen,

for indikering av støvtykkelse i et elektrisk forbruker-apparat, f.eks. et TV-apparat.

7. Anvendelse ifølge krav 6, hvor temperatur måles ved hjelp av en temperaturføler (15) i en gjenstand som er termisk tett knyttet til flaten, idet gjenstanden (15) tilføres varme med et varmeelement slik at flaten avgir varmestråling, hvilken avgivelse avhenger av støvlagets tykkelse.

8. Anvendelse ifølge krav 7, hvor temperatur også måles i en referansegjenstand (16) som ikke utsettes for støvbelegning, på tilsvarende måte som i gjenstanden (15), idet gjenstanden (15) og referansegjenstanden (16) tilføres kjente, eventuelt like, effekter, og en sammenligning mellom de målte temperaturer utgjør basis for anvist måleverdi fra indikatoren (19).

9. Anvendelse av en ultralydmåler for måling av svekning av ultralydenergi som sendes gjennom en støvmengde avsatt på en flate, samt av en indikator forbundet med ultralydmåleren for angivelse av en måleverdi som er en funksjon av svekningen,
for indikering av støvtykkelse i et elektrisk forbruker-apparat, f.eks. et TV-apparat.

10. Anvendelse av en trykksensor for måling av overtrykk frembrakt av en støvmengde avsatt på en flate, samt av en indikator forbundet med trykksensoren for angivelse av en måleverdi som er en funksjon av overtrykket,
for indikering av støv-vekt i et elektrisk forbruker-apparat, f.eks. et TV-apparat.

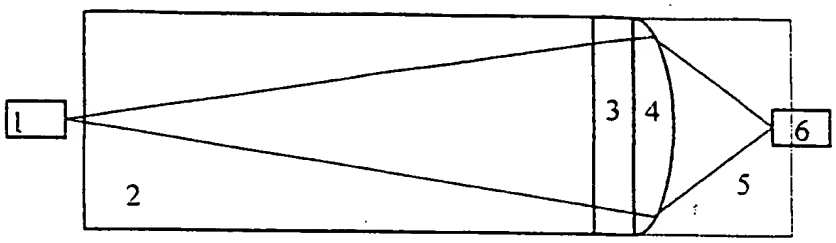
11. Anvendelse av en strekksensor for måling av bøyningsgrad for en plate som utsettes for tyngden av en støvmengde avsatt på en flate på platen, samt av en indikator forbundet med strekksensoren for angivelse av en måleverdi som er en funksjon av bøyningsgraden,
for indikering av støv-vekt i et elektrisk forbruker-apparat, f.eks. et TV-apparat.

12. Anvendelse ifølge et av kravene 2-11, hvor indikatoren fremviser kontinuerlig en måleverdi på en analog skala eller ved digital fremvisning.

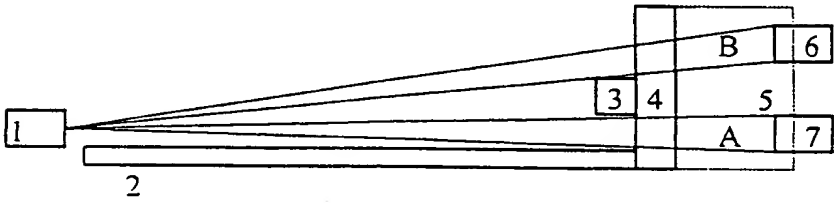
13. Anvendelse ifølge et av kravene 2-11, hvor indikatoren angir overskridelse av en terskelverdi for måleverdien ved å avgi et varselsignal som kan være av optisk eller akustisk type, eventuelt begge deler.

SAMMENDRAG

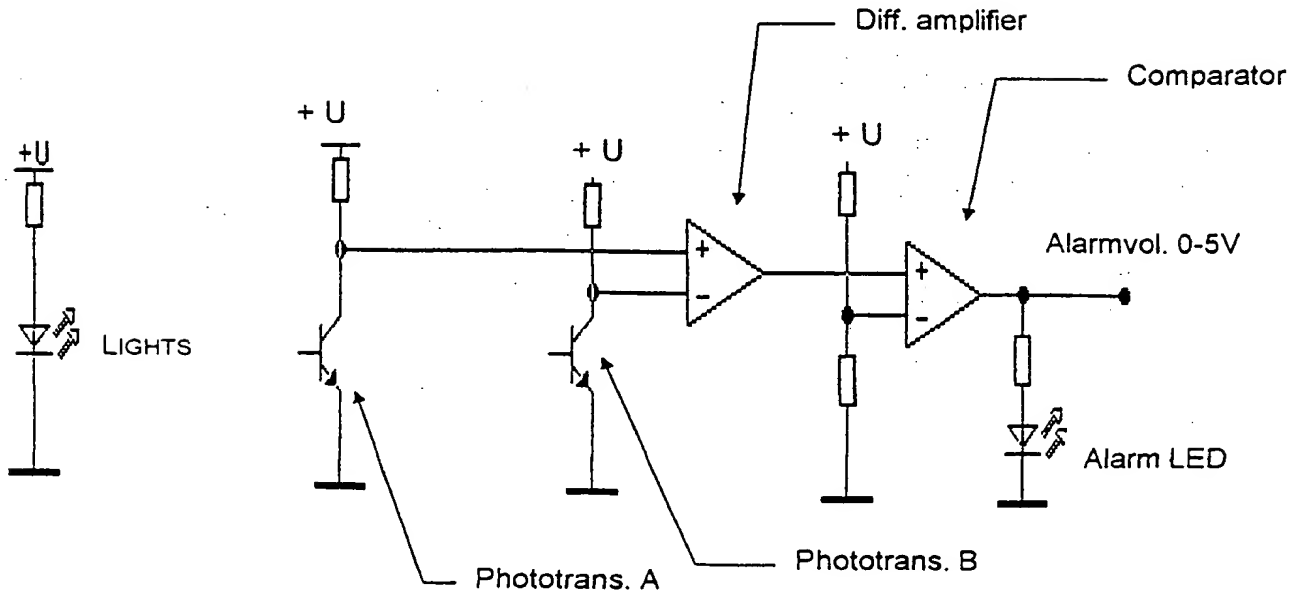
En fremgangsmåte og en anordning for indikering av en forurenset eller brannfarlig tilstand i et apparat eller et anlegg, baserer seg på måling av avsatt støvmengde på en flate i apparatet/anlegget. En måleanordning av optisk, termisk eller mekanisk type er signalmessig tilknyttet en indikator som fremviser en verdi eller angir en indikasjon for en parameter tilknyttet den avsatte støvmengden.



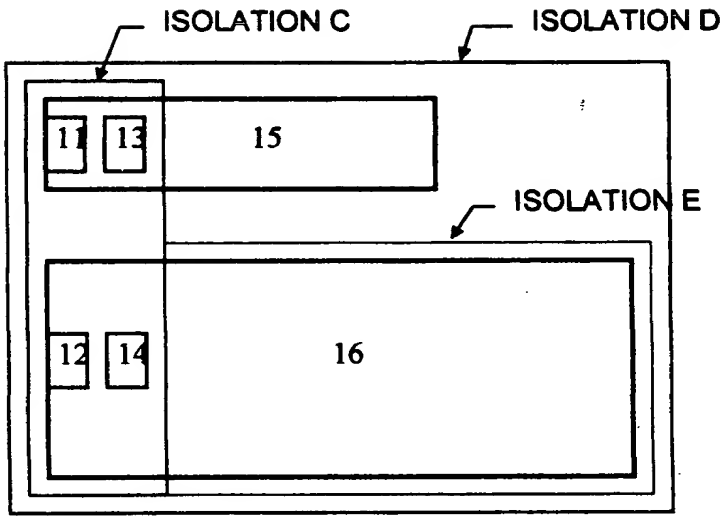
Figur 1a Dustdetektor from top



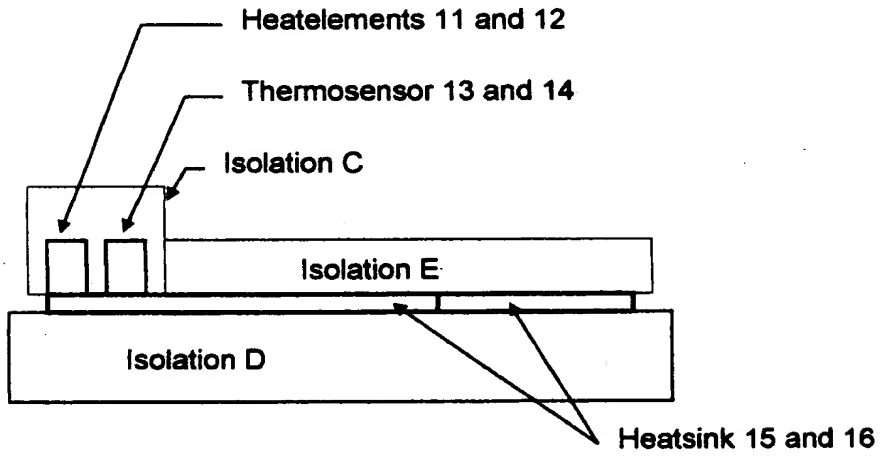
Figur 1b Dustdetektor from side



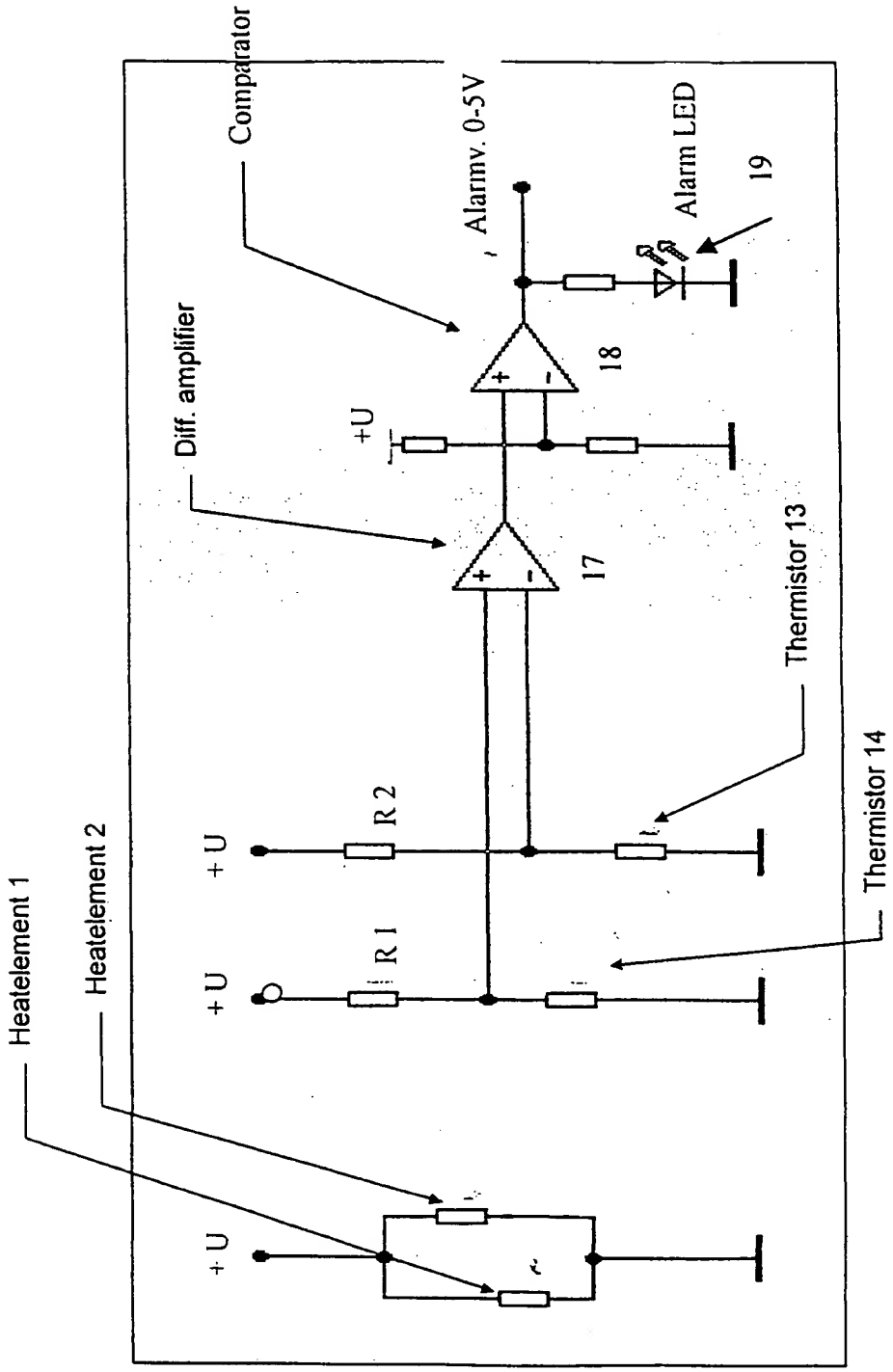
Figur 2 Schematic diagram for optisk detector



Figur 3a Thermic detector from top



Figur 3b Thermic detector from side



Figur 4 Schematic diagram for thermic detector

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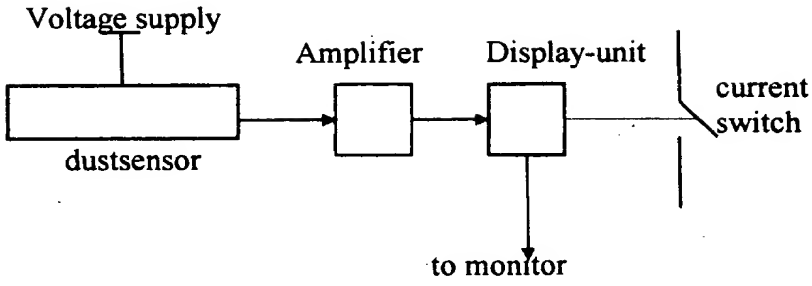

Figur 5

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G01N 21/47 — A1

(11) International Publication Number: WO 98/48261

(43) International Publication Date: 29 October 1998 (29.10.98)

(21) International Application Number: PCT/NO98/00121

(22) International Filing Date: 17 April 1998 (17.04.98)

(30) Priority Data:
971822 18 April 1997 (18.04.97) NO

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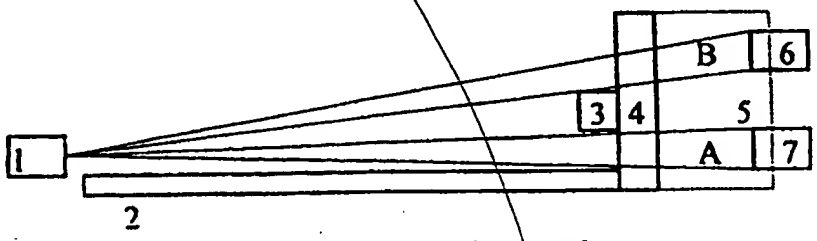
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.
In English translation (filed in Norwegian).

(54) Title: MONITORING DUST DEPOSITION

(57) Abstract

A method and a means for monitoring a contaminated or inflammable condition in an appliance or an installation is based on measuring deposited amount of dust on a surface in the appliance/installation. A measurement device of optical, thermal or mechanical type is attached signal–wise to an indicator that displays a value or provides an indication of a parameter attached to the deposited amount of dust.



Dustdetektor from side

Same invention

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BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
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BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
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BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
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CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
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CM	Cameroon			**PL**	Poland		
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CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

MONITORING DUST DEPOSITION

The present invention relates to monitoring a contaminated, dirty or inflammable condition caused by fallout dust. More specifically, the invention is directed to a new use of dust detection equipment to give warning of the presence or amount of dust or fine particles on a surface in an appliance.

A main purpose of an indicator for fallout dust is the prevention of fire and explosions. However, one may envisage several important purposes, e.g. (a) being able to prevent particular odour related to dust/particle accumulations, (b) being able to improve the efficiency of e.g. cooling units by preventing large accumulations of dust on cooling ribs, such accumulations impairing heat exchange capability, (c) general improvement/ increasing efficiency of cleaning/service/maintenance programs, i.e. demonstrating more easily a need for cleaning, (d) being able to maintain important parameters for electrical/electronic apparatuses within given tolerances.

In general it is previously known to measure dust and particle accumulations, however such measurements are typically made in industrial or research related environments. US patent no. 4,793,710 discloses e.g. a method for measuring dust layers in coal mines, based upon an optical technique, and US patent no. 5,412,221 also relates to an optical measuring method for small particle depositions ("fallout") in connection with space research. US patent no. 5,229,602 discloses an optical method for detecting contamination layers particularly on transparent surfaces (headlight glass, windshield) on vehicles.

However, the present invention is based on a need for safeguarding life , health and property also in a normal consumer environment, and then based upon solutions that can be mass produced at a low cost, especially in such a manner that measurement and display equipment can be integrated in an appliance that is usual in such a normal consumer environment.

In a consumer market that comprises products of the type TV sets, audio and video appliances, larger domestic appliances like refrigerators, stoves, etc., small domestic appliances like coffee makers etc., personal care appliances, computer products like PC's and additional equipment for such products, electrical installations in dwelling units like fuse boxes/panels, electric radiators, lamps etc., it is clear that a dust monitor may be of large interest, also in connection with the

allergy problems from which many people suffer. A good indication of dust accumulation in the close environment of an allergic subject may provide a good basis for demonstrating the efficiency of possible counter measures, or provide a basis for starting such counter measures.

As regards ordinary cleaning, a dust monitor in accordance with the invention can of course also be an aid quite simply in demonstrating the need of ordinary cleaning.

When the word "dust" is used in the present description of the invention, and in the patent claims, one has in mind dust of different types, fine particles, dirt etc. A starting point is that the dust in question is fallout dirt consisting of particles that may hover some time in the air. Additionally, within the concept of dust, it is possible to distinguish between house dust, industrial dust and traffic dust. House dust is a mixture of fabric fibers (various forms of fabrics like cotton), and pollen (different forms of pollen, i.e. grain, grass, flower pollen etc.). Industrial dust is various types of waste products like grinding dust from wood and metals, and other waste products (contamination, pollution). Traffic dust is a mixture of asphalt, exhaust and different types of gases (pollution).

Hence, the purpose of the invention is to provide a warning/indication regarding accumulation of dust in important positions for consumers, and in accordance with the invention this has been achieved through a use of the type defined in the appended patent claims.

In the following the invention shall be illuminated further by examining certain exemplary embodiments, and in this connection it is referred to the appended drawings, where

figs. 1a and 1b show schematically a dust meter of optical type, in views from above and from the side,

fig. 2 shows a circuit diagram for an optical detector used in the dust meter shown in figs. 1a and 1b,

figs. 3a and 3b show a dust meter of thermal type, in views from above and from the side,

fig. 4 shows a circuit diagram for a detector in connection with the thermal dust meter shown in figs. 3a and 3b, and

fig. 5 shows a dust meter that can be used in accordance with the invention, in its most general form.

A concrete use of the invention is, as mentioned above, in connection with detecting and giving warning regarding dust accumulation in a TV set. The embodiments now to be discussed with reference to the drawing are envisaged in such a connection, but it is emphasized once more that also other consumer appliances are of interest, as explained previously. In figs. 1 a and 1b appears a schematic layout for a dust meter that is mountable inside a TV set. A plate 2, preferably arranged horizontally will little by little accumulate dust and particles that are deposited from the air space above the plate. A light source 1 is arranged at the left end of the plate 2, which light source emits light in such a manner that it propagates at least along the top side of the plate 2, and in addition in a space above the plate that supposedly does not contain any dust, i.e. in such a height above the plate that it is improbable that a dust layer will ever grow that high. The two main light paths appear in fig. 1b, i.e. two light paths indicated by means of two divergent pairs of broken lines. (Light may of course also spread outside these directions, but such light will not be of any use in connection with the actual measurement.)

A screen 3 provides a division between the two light beams of interest, the two light beams being termed A and B, i.e. A in the dust layer area, B in the air space above the dust layer.

As appears from fig. 1a, it is favourable to have a wide light beam, or making the light beam spread such as shown in the figure 1, along the dust layer, in order to increase measurement sensitivity and to decrease uncertainty. A lens 4 collects both beam parts A and B to respective detection areas, where two separate detectors 6, 7 measure light intensities. The lens 4 may be a normal convex lens, or, such as indicated in the figure, a cylinder lens, since it may be sufficient to focus the light in the horizontal plane. It will be favourable to build both detectors 6,7, the lens 4 and the screen 3 together inside a closed box 5, indicated in the figure by broken lines.

The intensity of light beam A will be reduced when the dust thickness on plate 2 grows, while the reference light in beam B will not be influenced by this layer of dust. Dust on the light source 1 will attenuate both beams equally. It is possible to adjust the recordable dust thickness mechanically by adapting the height of the light slit between screen 3 and plate 2. The top surface of plate 2 should be dull so as to avoid reflections. As mentioned, it is favourable with a light

beam having a certain width in the horizontal plane, and this can e.g. be achieved by means of a (not shown) lens between the light source and plane 2, or by making the light source emit a relatively wide beam such as shown in fig. 1a.

Regarding the electric/electronic aspect of this matter, it is referred to fig. 2 which shows an easily realized design of the electrical circuitry that is necessary in connection with the configuration of fig. 1a/1b. The light source 1 is shown in a simple circuit at the left in the figure, in the form of a light-emitting diode (LED), and in the detection circuit to the right in the figure, detectors 6 and 7 are shown as phototransistors connected in a simple manner to provide input signals for a differential amplifier 8 (it is also possible to use photodiodes.) As the dust thickness increases, and thereby beam A is attenuated, the ratio between the two voltage inputs to the differential amplifier is upset, and the voltage output form the differential amplifier 8 will e.g. increase. This is detected by means of the comparator 9 which compares to a fixed reference voltage delivered by a simple voltage divider. If the output from comparator 9 exceeds a certain voltage, the alarm light diode 10 is switched on, and this represents a possible indication that an undesired thickness of the dust layer has been reached.

The electronic circuitry after the photo detector 6,7 will in reality depend on how the possible dust recordal shall be indicated, i.e. if, such as shown here, a light diode shall be lit, if a measurement value shall be exhibited in a display, or possibly in a TV screen, or a special indication may also be cutting the supply voltage of the TV set..

Hence, in the shown embodiment, the exceeded dust limit is marked by lighting a light diode, and by outputting a logic "high" signal. However, it is quite feasible to grade the alarm for indicating several thicknesses of dust, but this will then require a somewhat different circuit solution than what has been shown.

If the detector is to be located in an area where light can get in, the light source 1 should be modulated so that the receiver part can be AC coupled, such a solution has not been shown in the drawings either. The solution with a modulated light source will of course be a little more costly.

As a matter of principle, it will of course also be possible to transmit light "transversely" to the dust layer, that is in fig. 1b with a light source situated above plate 2, preferably with a light beam expanding element in the form of a lens, with a transparent or reflecting plate 2, and with detection below or above the plate

respectively. A reference measurement must then be made in some other manner, e.g. with a detector attached to the light source in a dust-free configuration, i.e built-in together with the light source.

Experiments that have been conducted in accordance with the solution shown in figs. 1a, 1b and fig. 2, show that the light traveling along the dust surface, will be attenuated approximately in proportion to the dust thickness. The experiments further indicate that the density of the dust layer is of little importance with this detection solution.

Quite different measurement techniques than optical detection can also be used regarding detecting dust layers, and in fig. 3a and 3b is shown a thermal detector for the same purpose. The principle utilized here, is based on the fact that a dust layer will have an insulating effect, so that the temperature in a heated surface will increase with increasing dust thickness. To achieve a reliable detection, a reference measurement toward a point that does not depend on the dust layer, should be used.

The thermal detector is built on an insulating support D in order to maintain a heat loss that is as small as possible in that direction. Heating elements may be two resistors 11 and 12 connected in parallel and placed on respective cooling surfaces 15 and 26, as shown in fig. 3a which is a top view of the detector. The cooling surface 15 is the actual dust sensor, which little by little shall be coated by dust, while cooling surface 16 is a reference. Cooling surface 16 is made insensitive to dust by covering it by an insulation layer E that is not too thick. Here it is a goal that the thermal resistance through insulation layer E shall be significantly higher than the thermal resistance in a dust layer, so that such a dust layer does not influence the heat emission from the cooling surface. In order to obtain sufficient cooling despite this, that surface is made relatively large.

Thermistors are preferably used as temperature sensors 13 and 14. (Other types of sensors are of course also of interest, e.g. thermocouples.) The dust sensor, i.e. the cooling surface 15, will have a reduced cooling effect when it is gradually covered by a dust layer, so that the temperature in the thermal sensor 13 will be a function of the dust thickness. The temperature in thermal sensor 14 will on the other hand stay substantially constant, even if dust falls upon the insulation layer E.

Closely adjacent to the thermal sensors 13 and 14 the temperature should be substantially higher than the ambient temperature. This is achieved by supplying sufficient power (about 1-5 watt), and by insulating above the thermal sensors and the heating elements (insulation layer C). The physical dimensions may be about 5 x 5 cm, and with a maximum height about 2 cm, see fig. 3b.

An example of a circuit diagram in connection with the thermal detector shown schematically in figs. 3a and 3b, appears from fig. 4. In the example in fig. 4, the end part of the detection circuit is rather similar to what appeared from fig. 2 regarding the optical detection circuit, i.e. from the differential amplifier 17 through the comparator 18 and to an alarm light-emitting diode 19. However, the photo-transistors 6 and 7 in fig. 2 are changed for thermistors 13 and 14 in fig. 4, for delivering signal voltages to the differential amplifier 17. Each one of the thermistors 13 and 14 is part of a voltage divider together with resistors, R2 and R1 respectively. The heating elements 11 and 12 are part of a separate, simple parallel circuit.

All resistors in the disclosed circuit, including the heating elements, should have a tolerance of 1% or better, while the accuracy of the supply voltage U is not critical.

Both the described solutions for detecting dust layer thickness are simple, and the total cost in mass production can be expected to be less than NOK 10 in both alternatives, the thermal solution being the cheaper one.

One further possibility for detecting a dust layer is a mechanical sensing method, which method can be based upon a strain principle or a pressure principle. The strain principle is based on bending a plate due to the dust weight. In such a case a strain gauge may be the actual sensor. When the pressure principle is used, a pressure sensor on the underside of an accumulation surface senses the weight of the dust layer, that is the superpressure coming gradually in addition to the start pressure caused by the weight of the surface/plate itself.

Independent of the type of sensor that is used, a signal from the sensor will normally have to be amplified, i.e. the amplifier succeeding the sensor, shall record current or voltage from the sensor, and adapt the level for the display unit that may be of various types. In order to make relative measurements, the amplifier should be a differential amplifier with the sensor in a measurement bridge.

Regarding the display unit, this unit may be of several different types. As shown in fig. 2 and fig. 4, display takes place by means of a simple light-emitting diode, which is lit when the dust layer reaches a certain thickness. It is of course also possible with a display of a more advanced type, e.g. for displaying the actual thickness of the dust layer, measured by means of a suitable unit of measure. A seven-segment type display or an intelligent display may then be utilized. Further possibilities are that the display unit may control a current switch for switching off the appliance in question if the dust thickness exceeds a critical value. Further possibilities include connection to a monitor screen with an opportunity for text in the screen. This last mentioned solution may e.g. be of interest if the dust monitor shall be built-in in an integrated manner in a TV set or a computer monitor.

In this last mentioned case it is favourable to manufacture the dust warning unit as an individual unit, or possibly as an integral part of an appliance. If the dust warning unit is produced as an individual unit, it must be suitable for fitting into the appliance at a later time. As an integral part, it will be included as a production element in an appliance, e.g. a TV set, and as previously mentioned, possibly at a very low cost.

The voltage supply may be standardized e.g. at 5,0 volts. This voltage may vary within a given range, without influencing the reliability of the dust monitor.

As previously mentioned, it is favourable to base the dust sensor on relative measurements, so that external and spurious influences shall not be disturbing.

Quite generally it is important to underline that the "warning" that shall take place, may take place in different manners. As mentioned above, one may most easily visualize a light indicator in some form (one further such indicator may be a simple luminous indication with a colour dependent on dust amount), but it may also be of interest to use an acoustic signal, i.e. some form of sound emission, and a text indication as mentioned above in connection with a TV set/computer monitor, is an important possibility. Of course, one may also visualize a combination of these indication modes.

It seems also favourable in certain applications to have the possibility that the display may provide information that the system is operational, and that it is working.

In fig. 5 appears a dust measurement device in its most general form, as mentioned above, i.e. independent of the physical measurement principle that

may be optical, thermal, weight-based, ultrasound-based, possibly based on measurement of electrical characteristics like resistance, capacity etc. Absorption/attenuation of other types of radiation than optical and ultrasound radiation can be envisaged, e.g nuclear radiation with a radiation source similar to the one that is utilized in smoke detectors. Thus, in this figure "the dust sensor", which normally will require a voltage supply, comprises some sensor type that is able to deliver a signal depending on the dust amount that is measured. The signal passes to an amplifier that delivers an output signal further to a display unit and possibly to an alarm unit. The display unit may preferably comprise or be attached to a monitor screen, and it may possibly be switchable on/off by means of a switch.

PATENT CLAIMS

1. Use of a measurement device (1, 6-9; 11-14, 17, 18) for measuring a parameter indicating amount of dust deposited on a surface, and of an indicator (10, 19) signal-wise connected to the measurement device for specifying an indication of the parameter,
for monitoring a contaminated, dirty or inflammable condition in an electrical consumer appliance, e.g. a TV set.

2. Use of an optical measurement device (1, 6-9) for measuring attenuation of a light beam (A) transmitted through an amount of dust deposited on a surface, and of an indicator (10) connected to the measurement device (1, 6-9) for specifying a measurement value that is a function of the attenuation,
for monitoring dust thickness in an electrical consumer appliance, e.g. a TV set.

3. The use of claim 2, wherein the output intensity of the through light beam (A) is compared to the intensity of a reference light beam (B) passing outside the amount of dust.

4. The use of claim 2 or 3, wherein the light beam (A) is transmitted along and through the dust layer, possibly as a divergent or expanded beam to increase measurement sensitivity, and which beam is then possibly focused towards a photodetector (7) by means of a lens (4) situated after said surface.

5. The use of claim 2 or 3, wherein the light beam is transmitted substantially transversely to the dust layer, possibly with a reflection against the underlying surface so that the dust layer is passed twice before detection.

6. Use of a thermal measurement device (11-14, 17, 18) for measuring heat insulating ability for an amount of dust deposited on a surface, and of an indicator (19) connected to the measurement device for specifying a measurement value that is a function of said heat insulating ability,
for monitoring dust thickness in an electrical consumer appliance, e.g. a TV set.

7. The use of claim 6, wherein temperature is measured by means of a temperature sensor (15) in an object that is thermally closely attached to said surface, heat being supplied to said object (15) by means of a heating element, so that said surface emits heat radiation, said emission being dependent on the thickness of said dust layer.

8. The use of claim 7, wherein temperature is also measured in a reference object (16) which is not subject to coating by dust, and in a corresponding manner as in said object (15), known and possibly equal power being supplied to the object (15) and the reference object (16), and a comparison between the measured temperatures constitutes a basis for specified measurement value from the indicator (19).

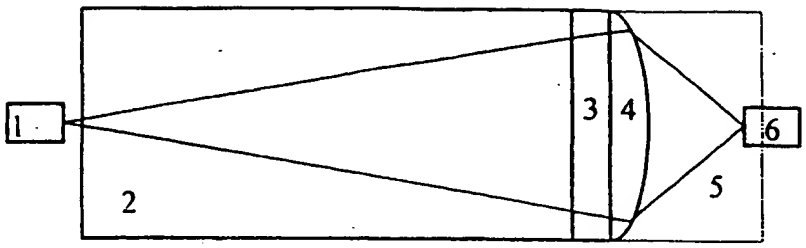
9. Use of an ultrasound measurement unit for measuring attenuation of ultrasound energy transmitted through an amount of dust deposited on a surface, and of an indicator connected to said ultrasound measurement unit for specifying a measurement value that is a function of the attenuation,
for monitoring dust thickness in an electrical consumer appliance, e.g. a TV set.

10. Use of a pressure sensor for measuring superpressure caused by an amount of dust deposited on a surface, and of an indicator connected to the pressure sensor for specifying a measurement value that is a function of said superpressure,
for monitoring dust weight in an electrical consumer appliance, e.g. a TV set.

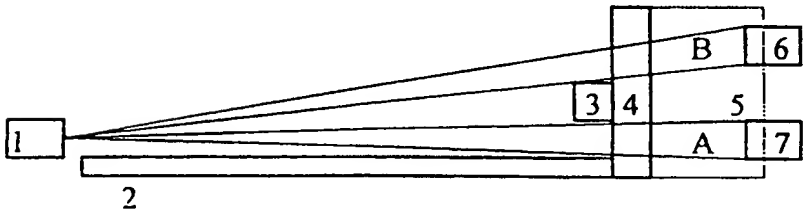
11. Use of a strain sensor for measuring degree of flexure for a plate that is subject to the weight of an amount of dust deposited on a surface on the plate, and of an indicator connected to the strain sensor for specifying a measurement value that is a function of the degree of flexure,
for monitoring dust weight in an electrical consumer appliance, e.g. a TV set.

12. The use of any one of claims 2-11, wherein said indicator displays continuously a measurement value on an analog scale or by digital display.

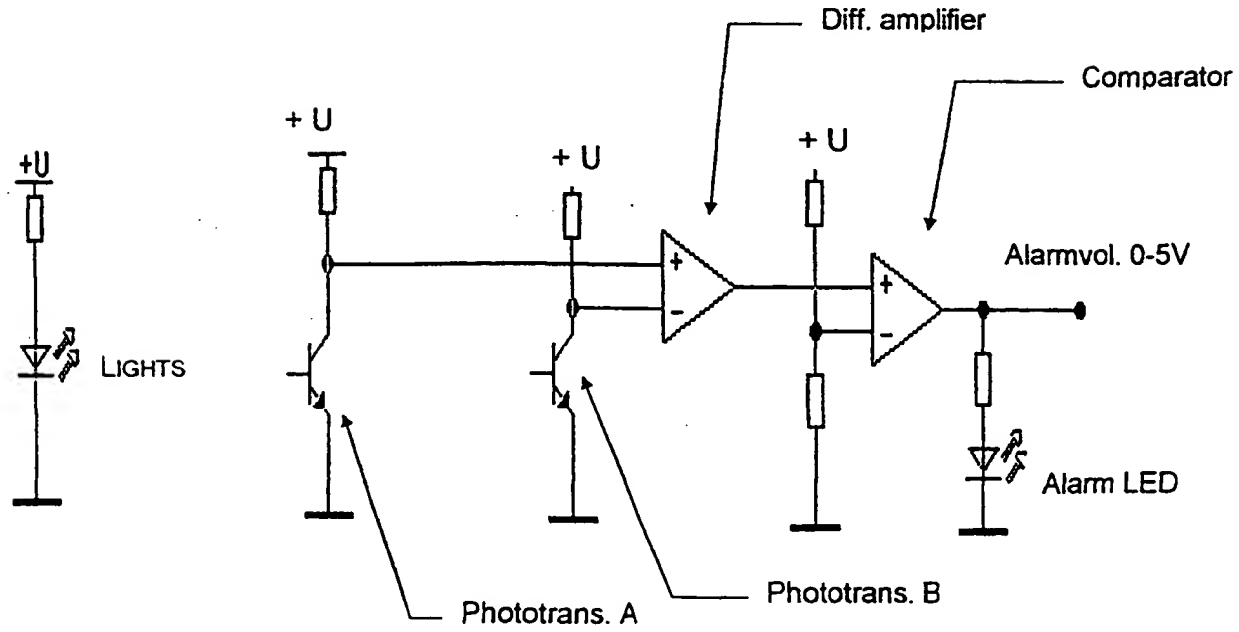
13. The use of any one of claims 2-11, wherein said indicator indicates the exceeding of a threshold value for said measurement value by delivering a warnng signal that may be of an optical or acoustical type, possibly both.



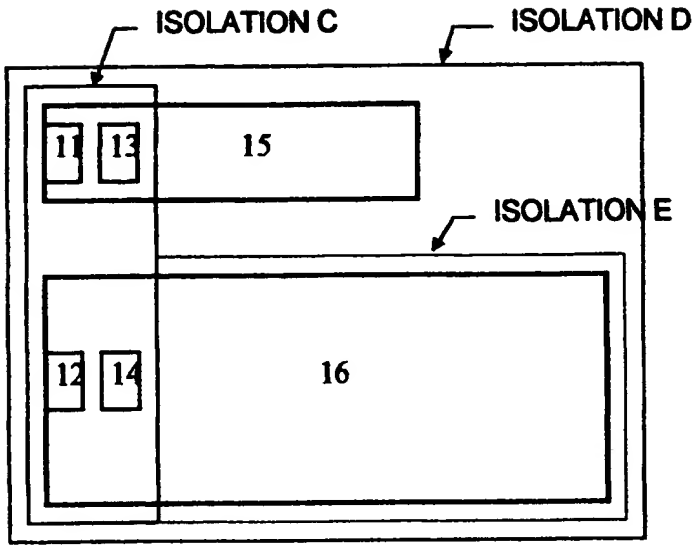
Figur 1a Dustdetektor from top



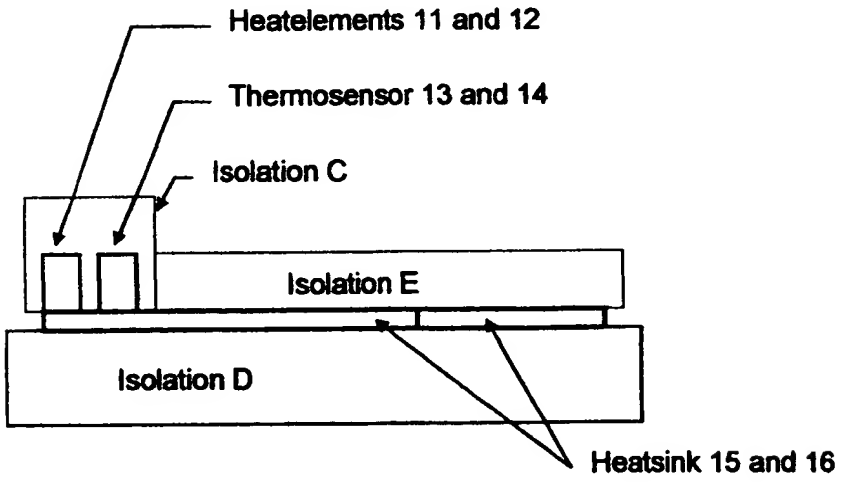
Figur 1b Dustdetektor from side



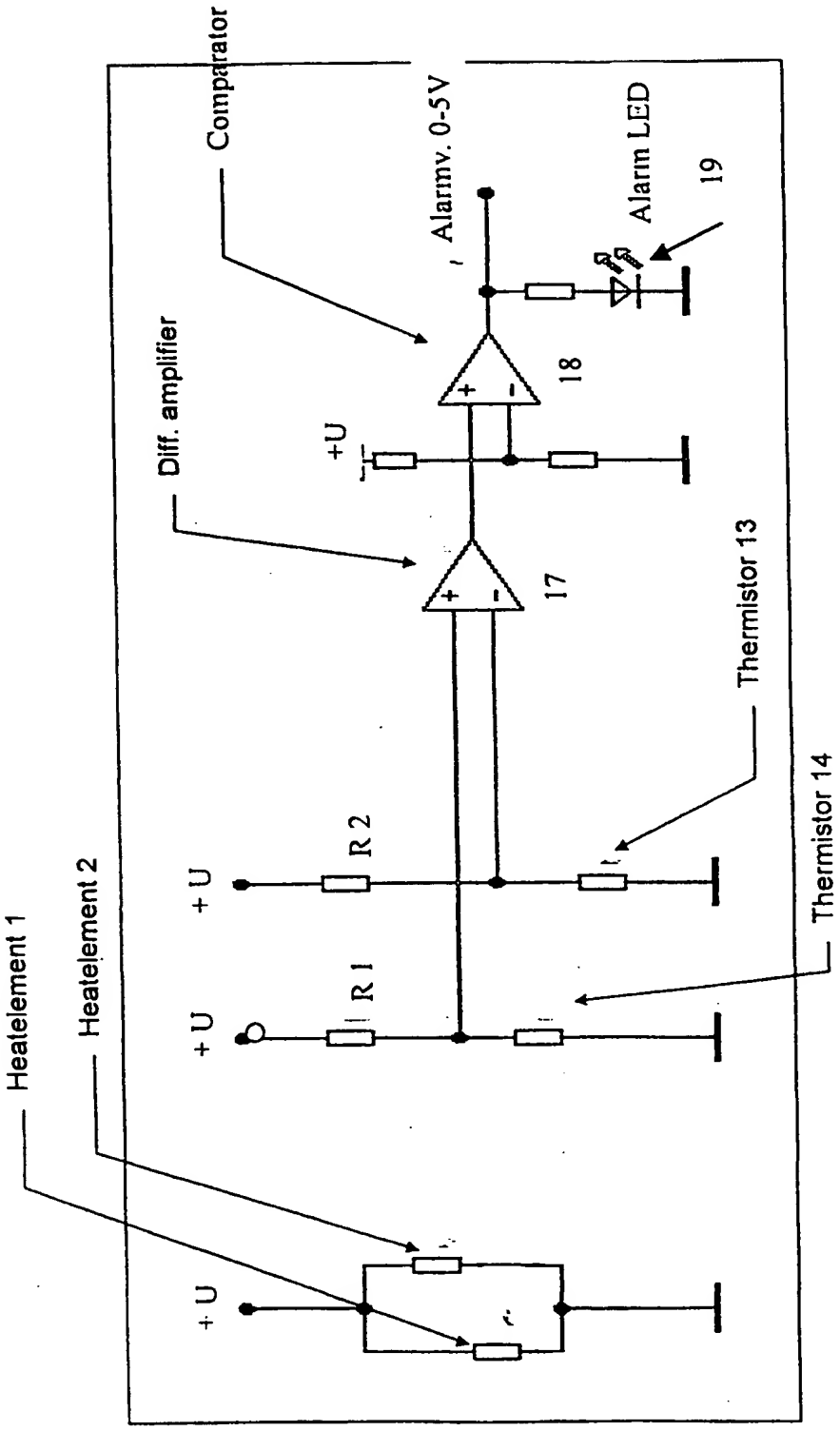
Figur 2 Schematic diagram for optisk detector



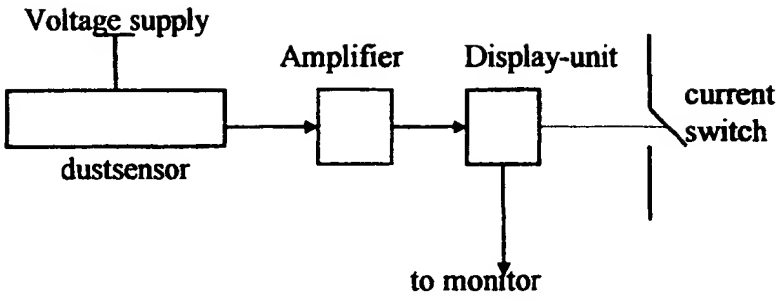
Figur 3a Thermic detector from top



Figur 3b Thermic detector from side



Figur 4 Schematic diagram for thermic detector


Voltage supply
Amplifier
Display-unit
current
switch
dustsensor
to monitor

Figur 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 98/00121

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G01N 21/47
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, TXTE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5412221 A (IHLEFELD M. CURTIS ET AL), 2 May 1995 (02.05.95), column 3, line 21 - line 38; column 4, line 8 - line 23, figures 2,3, claim 1 --	1-5,12,13
X	US 3777173 A (JAMES EDWARD LANDRITH), 4 December 1973 (04.12.73), figure 4, abstract --	1-5,12,13
X	US 4793710 A (MICHAEL J. SAPKO ET AL), 27 December 1988 (27.12.88), column 3, line 50 - line 66, abstract	1,2
A	--	3-5

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 August 1998	20 -08- 1998
Name and mailing address of the ISA/ Swedish Patent Office	Authorized officer

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 98/00121

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4916325 A (ANTHONY P. ROOD ET AL), 10 April 1990 (10.04.90)	1
A		2-5,12,13
	--	
X	US 5229602 A (PETER JÜLIGER), 20 July 1993 (20.07.93), column 1, line 8 - line 42	1
A		2-5
	--	

INTERNATIONAL SEARCH REPORT

International application No.
N098/00121

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-5,12,13

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

I. Claim 1 directed to the use of a measuring arrangement for measuring the amount of dust on a surface.

II. Claim 2-5, 12, 13 directed to the use of an optical measuring arrangement for measurement of a light ray passing through the dust on a surface and for indicating the amount of dust on the surface.

III. Claim 6-8 directed to the use of a thermal measuring arrangement for measurement of the thermal insulation of dust on a surface and for indicating the amount of dust on the surface.

IV. Claim 9 directed to the use of an ultra-sonic sensor for measurement of the amount of dust on a surface.

V. Claim 5 directed to the use of a pressure sensor for measurement of the amount of dust on a surface.

VI. Claim 11 directed to the use of a strain sensor for measuring the amount of dust on a surface.

The special technical features of these groups are:

Group I: the use of a measuring arrangement for indicating the presens of dust or dirt in an electrical apparatus.

Group II: the use of an optical measuring arrangement for measurement of the amount of dust.

Group III: the use of a thermal measuring arrangement for measurement of the amount of dust.

Group IV: the use of an ultra-sonic measuring arrangement for measurement of the amount of dust.

Group V: the use of a pressure sensor arrangement for measurement of the amount of dust.

Group VI: the use of a strain sensor arrangement for measurement of the amount of dust.

These groups of inventions are not so linked as to form a single general inventive concept. There is no technical relationship among those inventions involving one or more of the same or corresponding technical features.

INTERNATIONAL SEARCH REPORT

Information on patent family members

27/07/98

International application No.
PCT/NO 98/00121

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5412221 A	02/05/95	NONE	
US 3777173 A	04/12/73	CA 996990 A	14/09/76
		DE 2308586 A,B,C	30/08/73
		GB 1426751 A	03/03/76
		GB 1426752 A	03/03/76
		JP 1067681 C	23/10/81
		JP 48095244 A	06/12/73
		JP 52014101 B	19/04/77
		US 3870197 A	11/03/75
US 4793710 A	27/12/88	AU 604906 B	03/01/91
		AU 1695088 A	15/12/88
		DE 3818885 A	29/12/88
		GB 2206963 A	18/01/89
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